

What is Claimed:

- 1 1. An apparatus for the generation of high-energy terahertz
2 radiation comprising:

3 a source effective to produce optical radiation; and

4 a semiconductor substrate having a refractive index, n, and a photo-
5 generated dipole generated upon interaction with the optical radiation, the photo-
6 generated dipole oriented to radiate terahertz radiation having power at least about
7 n^2 times higher than the power of the terahertz radiation radiated by a photo-
8 generated dipole which is not so oriented.
- 1 2. The apparatus of claim 1 wherein the source is a laser that
2 produces pulsed optical radiation having a femtosecond duration.
- 1 3. The apparatus of claim 2 wherein the laser produces pulsed
2 optical radiation having a wavelength of about 800 nm.
- 1 4. The apparatus of claim 3 wherein the laser is a
2 titanium:sapphire laser.
- 1 5. The apparatus of claim 1 wherein the photo-generated dipole is
2 oriented substantially perpendicular to the propagating direction of the terahertz
3 radiation.
- 1 6. The apparatus of claim 1 wherein the semiconductor substrate
2 has a grating with an apex angle of about ninety degrees.

1 7. The apparatus of claim 6 wherein the size of the grating is up to
2 about 5 μ m.

1 8. The apparatus of claim 6 wherein the semiconductor substrate
2 is GaAs.

1 9. The apparatus of claim 6 wherein the optical radiation of the
2 laser is incident substantially perpendicular to the grating of the semiconductor
3 substrate.

1 10. The apparatus of claim 1 further comprising a structure of a
2 polytetrafluoroethylene base with an InAs film forming a grating on the surface of the
3 semiconductor substrate.

1 11. The apparatus of claim 10 wherein the grating has an apex
2 angle of about ninety degrees.

1 12. The apparatus of claim 10 wherein the InAs film has a thickness
2 greater than the absorbance length of the optical radiation.

1 13. The apparatus of claim 10 wherein the optical radiation is
2 incident substantially perpendicular to the grating of the semiconductor substrate.

1 14. The apparatus of claim 1 wherein the semiconductor substrate
2 has a grating formed by a series of structures each having the configuration of a
3 right triangle.

1 15. The apparatus of claim 14 wherein the optical radiation is
2 incident on the surface of the semiconductor substrate at the Brewster's angle to
3 each individual structure of the grating.

1 16. A method for the generation of high-energy terahertz radiation
2 comprising:

3 providing a semiconductor substrate having a refractive index, n, and
4 a modified surface;

5 applying an electric field to the semiconductor substrate; and

6 directing optical radiation to the semiconductor substrate, thereby
7 creating a photo-generated dipole emitting terahertz radiation,

8 the photo-generated dipole oriented by the modified surface of the
9 semiconductor substrate to emit terahertz radiation having power at least about n^2
10 times higher than the power of the terahertz radiation radiated by a photo-generated
11 dipole which is not so oriented.

1 17. The method of claim 16 wherein the photo-generated dipole is
2 oriented substantially perpendicular to the propagating direction of the terahertz
3 radiation.

1 18. The method of claim 16 wherein the semiconductor substrate is
2 GaAs, the surface of the semiconductor substrate is modified by a grating with an

3 apex angle of about ninety degrees, and the optical radiation is incident substantially
4 perpendicular to the grating of the semiconductor substrate.

1 19. The method of claim 16 wherein the surface of the
2 semiconductor substrate is modified by a polytetrafluoroethylene base with an InAs
3 film forming a grating on the surface of the semiconductor substrate, the InAs film
4 has a thickness greater than the absorbance length of the optical radiation, and the
5 optical radiation is incident substantially perpendicular to the grating of the
6 semiconductor substrate.

1 20. The method of claim 16 wherein the surface of the
2 semiconductor substrate is modified by a grating formed by a series of structures
3 each having the configuration of a right triangle and the optical radiation is incident
4 on the surface of the semiconductor substrate at the Brewster's angle to each
5 individual structure of the grating.